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INFANTRY NUCLEAR WEAPONS

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We have all seen more than once in science fiction films how a special forces unit soldier, usually a warrior of the "light forces," destroys an entire enemy company with one shot or smashes some alien monster into dust. Is this possible in reality? Oddly enough, the answer is yes. Perhaps if small arms fire nuclear bullets.

It is well known that one of the main elements of any nuclear weapon is the so-called fissile material. In atomic munitions it is the main source of energy released during the decay of atomic nuclei of heavy elements; in thermonuclear munitions it is a kind of "fuse", the activation of which creates a very high temperature and pressure, which ensures the initiation and conditions for the reaction of nuclear fusion, i.e. the joining of atomic nuclei light elements into heavier ones (for example, the synthesis of one helium atom nucleus from two deuterium atom nuclei), accompanied by the release of colossal energy.

In nuclear weapons, the fissile material is usually **uranium 235** or **plutonium 239** . In nuclear physics, there is the concept of "critical mass" - the volume of fissile material at which a fission chain reaction occurs and, as a consequence, an explosion. For **uranium** and **plutonium,** this parameter is at least 1 kilogram of the substance.

Quite logically, questions arise: what can nuclear bullets be made from? If the weight of one "fuse" based on traditional fissile substances is at least 2–3 kg, what could be inside it? Physicists give the answer to this question. Nuclear bullets can be made from the transuranium element **californium** , or, to be precise, from its radioactive isotope - *california* **252** (^{252} Cf).

The ^{252}Cf isotope has found its greatest use as a powerful source of neutrons in neutron activation analysis and radiation therapy of tumors. In addition, the ^{252}Cf isotope is used in experiments to study the spontaneous fission of atomic nuclei. During its decay, californium 252 exhibits the property of effective nuclear fission with the formation of 5 to 8 neutrons. And this is surprising, since uranium and plutonium are second! [1]

The first and simplest way to produce californium is the explosion of a powerful thermonuclear weapon filled with plutonium, since the neutron flux density in this case is billions of times higher than in others. It was in this way that the isotope was obtained in the Soviet Union until nuclear tests were banned. The uniqueness of the technology is evidenced by the fact that almost no one knows the name of the closest associate of the famous academician I. Kurchatov, academician Mikhail Yuryevich Dubik, who was tasked with solving the problem of producing a valuable isotope in the shortest possible time. The technology developed by the academician still remains secret, although something has become known. Soviet
nuclear scientists made special neutron trap targets, in which californium was formed from plutonium during explosions of powerful thermonuclear charges.

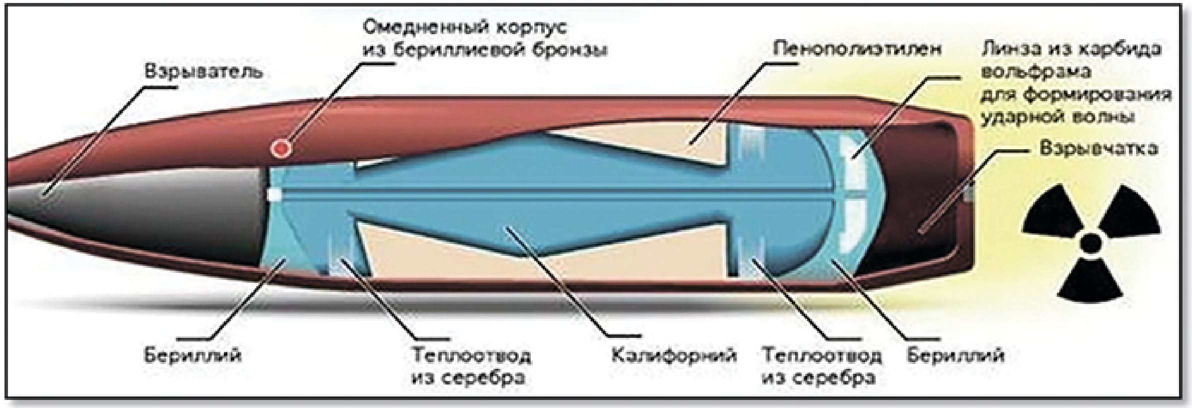
The second method of production is the irradiation of elements such as plutonium or **curium** in nuclear reactors, followed by chemical isolation of the desired isotope. At the same time, the duration of irradiation ranges from 8 months to 1.5 years, which determines the prohibitive cost of the substance and the meager volumes of its production [2].

According to estimates, 20–40 milligrams of this isotope are mined annually in the world, and its total global reserve does not exceed 10 grams [1]. However, during the period of intensive nuclear testing in the atmosphere, the Soviet Union had the opportunity to possess a significantly larger amount of relatively cheap Californian. This substance has an atomic weight of 252 units. Surprisingly, ***the californium isotope***

Soviet physicists were inspired by their success: it was enough to take just a pea of Californian 252, and they could produce a powerful atomic explosion! This incredible discovery marked the beginning of the development of a top-secret project to create a new type of weapon - a miniature nuclear explosive device [2].

One of the unique inventions was mastered by physicists during the Cold War; according to available information, it even went as far as full-scale testing. The news that nuclear bullets were created and tested by domestic defense technology specialists appeared in the information space relatively recently and became a real sensation. All documentation about secret developments was kept under seven seals. Only after the USSR collapsed and Semipalatinsk became part of sovereign Kazakhstan did secret information begin to leak into the media. It was then that it became known what these munitions could be.

The description and characteristics of this fantastic weapon surprised many. In the test reports, references were allegedly found to experiments in which the energy release was designated as “less than 0.002 kt,” that is, as when detonating two tons of explosives! Several documents that appeared on the Internet were truly sensational. They talked about nuclear ammunition for small arms - special 14.5 mm and 12.7 mm caliber cartridges for heavy machine guns (Vladimirov and Degtyarev-Shpagin), but the most amazing thing was the mention of 7.62 mm caliber cartridges for the Kalashnikov series machine gun PC! The cartridge for this machine gun could become the world's smallest nuclear weapon. However, **a number of serious experts**



The design of the bullet itself is not complicated: a part weighing 5–6 grams is made from the California isotope, shaped like a dumbbell with two hemispheres on a thin stem. Hitting the target, a tiny explosive charge inside the bullet crushes it into a neat ball, which for a 7.62 mm caliber bullet can have a diameter of 8 mm, and a supercritical state occurs and… that's it - a nuclear explosion is guaranteed! To detonate the charge, it is possible to use a contact fuse, which is placed inside the bullet - that's the whole "bomb for a gun"! As a result, the bullet, however, would turn out to be much heavier than a regular one, therefore, in order to maintain the usual ballistic characteristics, a charge of high-power gunpowder would have to be placed in the cartridge case and the weapon would have to be modified accordingly [2]. Externally, nuclear weapons could look like shown in **Figure 3.**

What could be the impact of this ammunition on the target? It would be special because ultra-small nuclear charges interact with the environment in a fundamentally different way than classical nuclear charges. The result is not similar to ordinary chemical explosives. After all, with the explosion of one ton of chemical explosives, many tons of hot gases are formed, uniformly heated to a temperature of two to three thousand degrees. And here is a tiny ball that cannot transfer all the energy of nuclear decay to the environment. Therefore, the light radiation and shock wave are quite weak compared to chemical explosives of the same power **(Fig. 4)** , but penetrating radiation, on the contrary, receives a much larger share of energy and becomes the main damaging factor.

As a result, it is necessary to shoot at the maximum target range, but even in this case the shooter can receive a noticeable dose of radiation. So the maximum burst that it would be advisable to fire is limited to two or three shots.

Available information suggests that the TNT equivalent of a nuclear bullet could be from 100 to 700 kg, although conventional explosives would have caused much greater destruction. The amount of damage would directly depend on the conditions in which the bullets were stored and the material of the chosen target. But the results that could be obtained are impressive. Thus, calculations show that dynamic protection and the hitting the brickwork of a building would evaporate a whole cubic meter of brick, so three hits at the fastening points of structures could easily collapse the floors, or even the entire permanent building [3].

At the same time, a strange effect was discovered when a bullet hit a tank of water. A nuclear explosion might not have happened in this case - water, especially “heavy” water, slows down and reflects neutrons well. In addition, slow neutrons fission nuclei more efficiently, and the reaction begins before the bullet hits the wall of the tank, which could lead to the destruction of the bullet's structure due to extreme heat. In this regard, it became possible to use the resulting effect to protect tanks from subminiature nuclear weapons by attaching so-called “water armor” to them, or more simply, containers with heavy water [2].

However, the main problem that could ultimately decide the fate of these unique ammunition is the heat generation caused by the continuous decay of californium. The fact is that all radioactive materials decay, which means they heat up, and the shorter their half-life, the stronger the heating. A californium core bullet should produce about 5 watts of heat. At the same time, due to its heating, the characteristics of the explosive and the fuse could change, and strong heating was simply dangerous, since the bullet could get stuck in the chamber or in the barrel, or, even worse, spontaneously explode when fired.

Therefore, to store such bullets, a special refrigerator was required, which seemed to have been designed and looked like a copper plate about 15 cm thick with slots for 30 rounds. Between them there were channels through which coolant circulated under pressure - liquid ammonia, which provided the bullets with a temperature of about -15 ° C. This installation consumed about 200 watts of electricity, and weighed about 110 kg, so it could only be transported on a specially equipped conveyor In classic nuclear weapons, the just 30 minutes after it was removed from the refrigerator, and during this time it was necessary to load it into the magazine (tape), take a firing position, select the desired target and fire at it shot.

If it was not possible to fire during this time, the cartridge should have been returned to the refrigerator and cooled again. Well, if the bullet was outside the refrigerator for more than an hour, then it would be strictly prohibited to use it, and it itself would have to be disposed of using special equipment [2].

The shelf life of these unique ammunition, according to media reports, would not exceed six years, so none of them, if they actually existed, have simply been preserved since then. Of course, no one will undertake to claim that the improvement of such weapons has not been carried out and is not being carried out at the present time. However, the laws of physics are very difficult to circumvent, and the fact that bullets filled with transuranic elements heat up very much, require cooling and do not give the desired effect when dropped into a tank of heavy water is a proven scientific fact. All this limits the possibilities for their use, and in the most serious way.

In addition, those reserves of californium that were obtained through powerful nuclear explosions disappeared quite quickly. There was only an alternative way to obtain it - using a nuclear reactor. However, this method is very expensive, and the yield of the valuable element is scanty.

In general, whatever one may say, nuclear bullets with Californian as a filling have many negative characteristics:

get very hot during storage;

they must be used no later than half an hour after being removed from the "refrigerator";

unstable and unregulated charge explosion power;

are neutralized when exposed to water;

too expensive to produce fissile material.

The combination of these circumstances may have been the reason why the incredible project called “Nuclear Bullets” was abandoned until better times. The point is not even that there was a pity for money for the further development of this type of weapon. Most likely, the country's leadership would have considered this project inappropriate, too expensive and exotic for the early 80s. In addition, it was probably convinced that the enemy could be destroyed by other ammunition that did not require so much effort to produce, store and move. In this regard, the project in question, if it actually existed, obviously went to gather dust on the shelves of secret archives.

It is necessary to emphasize once again that there is no exact data on the development of infantry nuclear weapons in open sources in open sources. All of the above may well be the fantasies of a number of authors, but these fantasies are based on serious scientific foundations and are theoretically quite realizable.

No one can guarantee that research is not currently underway to improve miniature nuclear weapons with californium or other transuranium elements. Of course, it is necessary to carry out titanic work in order to make them convenient for use and reduce the cost of production, because it is quite difficult to resist the laws of physics. Perhaps a fourth-generation nuclear weapon will appear, which will open up new horizons for nuclear waste make it possible to obtain californium from curium in reactors.

Technologies are developing at a high pace, because our scientists have solved the problem of cooling the infrared homing heads of the domestic man-portable anti-aircraft missile systems “Strela” and “Igla” to -200° with liquid nitrogen. So one of the problems already has a solution. Sooner or later, if necessary, portable cooling systems for magazines with nuclear cartridges can be created.

There is no doubt that work on creating miniature nuclear weapons is underway. Recent publications in the American media have forced everyone to remember what nuclear bullets are. In one of the military laboratories in Texas **(Fig. 5),** a group of physicists conducted a series of experiments related to testing ammunition filled with hafnium isomer. In order to obtain this substance, the nucleus of an element's atom was irradiated with X-rays.

Hafnium is a chemical element of the 4th group of the long-period form of the periodic system of D.I. Mendeleev (according to the short form of the periodic system - a secondary subgroup of group IV), sixth period, with atomic number 72. Denoted by the symbol Hf (lat. Hafnium) **(Fig. 6)** .

A simple substance is a heavy, refractory silvery-white metal. The average hafnium content in the earth's crust is about 4 g/t. On average, about 70 tons of hafnium are mined annually in the world. Prices for 99% of hafnium on average do not exceed $1000 per kilogram [4].

During research into the forced decay of the isomer, scientists were amazed: during the decay process, the amount of energy released was 60 times greater than the cost of initiation. The quality of the radiation obtained during the decay consisted mainly of the gamma spectrum, which is destructive for living

Still, it is obviously too early to write off nuclear weapons for small arms. This, of course, is incredibly exotic, but the possibility of their creation and the design basis are there, but there are no guarantees that the corresponding ammunition has already been created **(Fig. 7)** .

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